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ORCHARD STUDIES---VIII. On the Occurrence and Treatment of Fire Blight in the Pear Orchard.

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ORCHARD STUDIES.

VIII.—On the Occurrence and Treatment of Fire Blight in the Pear Orchard.

In Bulletin No. 49, dated February, 1895, there was published a report upon the pear orchard, which dealt with the culture and the methods of treatment of the same for common troubles. That bulletin also gave somewhat detailed notes on varieties, giving the results of our tests up until the date mentioned. Since the publication of Bulletin No. 49 a considerable number of varieties of pears have been added to the test orchard, yet there is nothing of particular importance to report at this time concerning these new additions. They are all mentioned in Bulletin 128, recently published, and such of them as are worthy of commendation a brief note to that effect appears in this latter bulletin. At this time it appears important to publish only a brief statement dealing with the further behavior of the varieties reported upon in Bulletin 49, more especially in regard to the occurrence of fire blight in the experiment orchard.

At the time that Bulletin 49 was written (December, 1895) the test orchard of varieties of pears had been maintained in excellent health, and there had been only the slightest trace of blight (*Micrococcus amylovorous*) occurring on any of the varieties, though they had then been seven years planted. This continued to be the case up until the spring of 1899, when the pear orchard was ten years old. At this time the blight showed more abundantly, but still not enough to cause much alarm, as it did not seriously attack any of the varieties except Leconte, Idaho, and to a lesser degree a few others. Up until that date we had been able to control the trouble by cutting away the diseased portions, in accordance with the old recommendations so frequently made, and we had supplemented this treatment by the thorough use of the Bordeaux spray. The work appeared to show that by careful attention to the removal of diseased twigs, and covering the plants with the Bordeaux spray at the proper time, one might be

able to grow pear trees successfully with but a slight amount of injury from fire blight. However, beginning with the spring of 1900, the attack of blight upon this orchard became very severe, and, regardless of cutting out diseased wood and thorough application of the Bordeaux spray, the attack progressed so rapidly that some of the trees were entirely destroyed before mid-summer, and in a few cases the entire set of four trees of certain varieties in the test orchard all died and were cut out and burned. This rapid progress of the disease, which appeared to defy the ordinary remedial agencies, made it seem likely that the whole orchard would be destroyed.

The specific notes on the injuries suffered by the several varieties will be given below in this paper. In the further effort to save the pear orchard, the trees were carefully gone over again in the winter of 1900-1901 and all blighted wood removed, except blight spots on the trunks and main limbs of trees that we desired to make a further effort to save. These were carefully scraped, removing all the dead bark as far as possible without cutting into the live tissues, and later the trunks and main limbs were treated with a lime-bluestone wash, as hereafter specified.

Treatment During 1901.

Being determined to still further test the efficacy of the old line of treatment for pear blight, we most carefully searched out all the blighted wood and treated the trunks and limbs as above specified. The topical application of remedies was begun March 12, 1901, by spraying all the trees so as to thoroughly drench them with a solution of bluestone, 2 pounds to 50 gallons of water. The trees were entirely dormant at this time, and, in fact, did not start into growth for some weeks.

On April 26th, just as the buds were pushing out, the orchard was again thoroughly sprayed so as to coat the trees to the tips of the twigs with Bordeaux mixture, made by the usual formula employed at this Station, known as the 4-5-50 formula. At the same time the trunks were painted with the lime-bluestone wash made by using 2 pounds of bluestone, 4 pounds of lime and 3 gallons of water, prepared as follows: The bluestone was dissolved in hot water, the lime was slaked carefully in hot water, then the

two were mixed together in a thick paste, and thinned so as to make three gallons of the preparation. This was applied so as to thor-

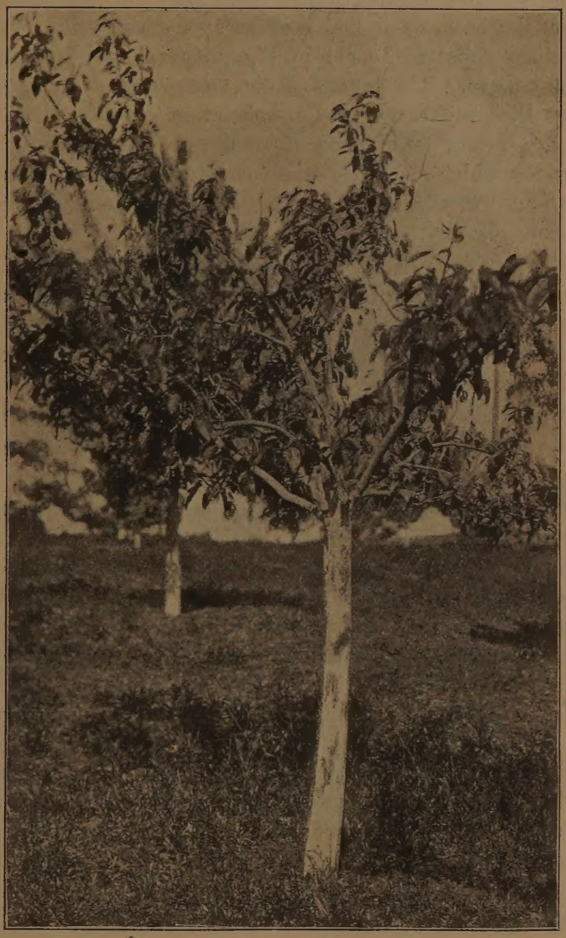

Fig. 16—Bosc, showing progress of blight.

oughly coat the trunks and main limbs, and gave the trees the appearance of a heavy coat of blue lime wash.

The above mixture was varied slightly by making as follows: 1 pound of bluestone, 3 pounds lime and 2 gallons of water. This was done thinking that perhaps the stronger mixture might be too severe on the bark, as it had been scraped quite thin; but the two preparations appeared to act in like manner, and in neither case caused any harm. The trunks of the trees showed during the summer that the preparation was beneficial in cleaning them up, and produced a rather tonic effect upon the growth of bark. In most cases trunks which showed distinct cases of fire blight recovered in part, and such trees are now living, with every probability that they will largely recover.

On May 18th the entire pear orchard was again sprayed with the regular Bordeaux mixture. The varieties at this time were just passing out of the bloom period, and we endeavored to apply the wash so as to furnish complete protection to all the growing surface then exposed to infection.

On May 23d the same application was repeated, as the blight at this time was appearing in many places throughout the orchard. Cold, misty, rainy weather prevailed.

Examination of the blighted areas on the trunks at this time showed that those areas affected with the true pear blight were exuding a dark, viscid sap, which in many cases streamed part way down the trunks, showing a distinct dark streak over the blue lime wash; and upon examination this sap showed the germs of the pear blight in great numbers. Pure cultures were made in the laboratory. The black streaks referred to show in the cut, Fig. 16. Blighted areas on the trunks and limbs which appeared to be caused by the canker fungus (*Sphaeropsis malorum*) in no instance showed this exudation of sap. The fruiting spurs and the terminal shoots showed decided cases of blight generally throughout the orchard at this date.

With the aid of several students at this time (May 23d), we carefully removed all fresh infection of blight which could be found by cutting away the diseased tissues. This material was collected as cut away and removed from the orchard and destroyed.

June 4th the pear blight was again quite general throughout the orchard, and certain trees were so badly diseased that we decided to remove them. The progress of the disease from this latter date was so decided that we gave up all attempts to remove the blighted

wood and contented ourselves with making observations on the progress of the disease, without attempting any further treatment during the summer. At the end of the season of 1901 the orchard presented a most serious condition of affairs. A considerable number of trees had already been removed, others had been cut to stumps, and it was now necessary to again remove a considerable number

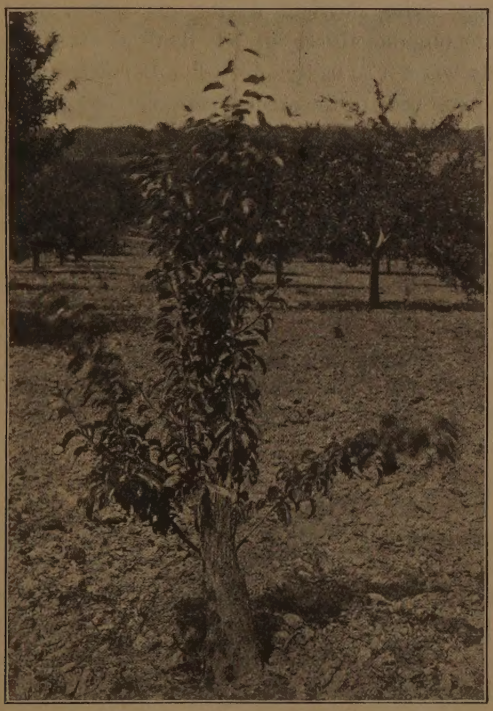

Fig. 17—Bosc, cut to stump, sprouts after one year's growth.

of trees and to cut others back to mere stubs or to short spurs of limbs around the head of the trunk, in order to remove, as far as possible, the diseased wood. The illustrations show the appearance of some of the trees in this orchard during the summer of 1901.

The experience in regard to the unprecedented development of blight at the Experiment Station orchard was almost paralleled at

the private place of the writer, on his farm in Bedford county, and the observations there made are mentioned in this bulletin. The pear orchards planted on my farm are not the same age as the trees in the Experiment Station orchard, being planted chiefly in 1894, nor are there so many varieties; but the behavior in regard to blight was quite identical. Bartlett and Duchess blighted very badly, a number of trees dying outright during the season of 1900; and Beurre Brignais blighted also so severely that some trees were cut out, but this variety was not so badly affected as Bartlett. Kieffer, which comprises the main body of the orchard, blighted to such extent that it seemed even this variety would yield to the disease. As there were about 2,000 trees in these orchards, I thought it best to make a rather strong effort to save them; hence, after having all the blighted wood cut out in the winter of 1900-1901, I decided to try a tonic application to the trees in the early spring. The orchards are on thin land, and I decided to use a fertilizer prepared by taking two parts of 16 per cent. dissolved South Carolina phosphate and one part of ordinary muriate of potash. This was applied about 500 pounds per acre, with a view of observing its effects on the health of the wood growth. The mixture was thoroughly prepared and applied around the trees broadcast in March, 1901, and cultivated in. No treatment in the way of Bordeaux applications was made, and the pear orchard was given no summer cultivation—in fact, we have for years avoided summer cultivation in the pear orchards.

Observation of the pear orchard at my farm during the summer of 1901 showed scarcely a foot of blighted wood, and some of the trees which had been cut back to stubs threw out sprouts from above the graft and started new tops. Bordeaux treatment was not given in this instance.

From the work done in this desultory manner at my farm it appeared that the stimulation of the trees seemed to have a beneficial effect in checking the blight, as other orchards blighted just as badly in 1901 as in the year 1900, consequently we resolved to pursue this question of stimulation much more thoroughly with a view of testing its efficacy.

Treatment of the Station Orchard During 1902.

During the winter of 1901-1902 the trees were carefully searched for blighted wood and the same removed, except where certain

Fig. 18—Sheldon, forming new head about top of trunk.

blight spots on the trunk and main limbs could not well be cut away without destroying portions of the trees which were yet alive. Those trees which were thought to be quite beyond remedial treatment were cut out. All the wounds made in the heavy cutting of diseased tis-

sue were covered with thick white lead paint, this being our usual custom in such work.

During the last week in March the pear orchard was sprayed so as to thoroughly drench all parts of the trees with a lye wash, made by using concentrated lye in solution, so as to give a strength of 3 degrees on the Beaume acid spindle, it requiring about 7 pounds of the concentrated lye to each 50 gallons of water to make the strength required. This wash was given for its cleansing effect, as has been our custom to do about once in three years.

On April 3d the trees still remaining in the pear orchard were treated as follows with a prepared fertilizer composed of 300 pounds of 16 per cent. dissolved South Carolina phosphate and 150 pounds of muriate potash. There were seventy-five trees still standing in the pear orchard, and this quantity of fertilizer was sowed broadcast in equal quantities around these trees, thus making an application of 6 pounds per tree. The ground had been previously cultivated with a disk harrow, and after the application of fertilizer was made a light cultivation was given with a straight-tooth harrow. The plants were still dormant. About two weeks later the orchard was recultivated with the disk harrow, and no further cultivation given for the year.

On April 25th the pear orchard was given the first spraying of Bordeaux, made in the usual manner. The buds were just bursting at this date, and the trees were coated so as to show a thin layer of bluish powder when dry.

On May 7th the pear trees were given the second spraying with the Bordeaux mixture, care being taken to thoroughly treat all parts of the trees and to again coat the limbs and trunks with the spray preparation. This was the last treatment with Bordeaux for that season.

Slight trace of blight showed here and there on the early growth, but no serious development of the disease occurred. The only noticeable progress that the disease made during the season was on limbs and smaller branches adjacent to hold-over cases which were not cut out at the winter pruning as noted above. No summer pruning for blight was attempted during 1902. The diseases developed from hold-over cases so as to result in the death of a few large limbs and occasional branches, but there was no spread of the trouble to the

young wood as the season progressed. The trees in many instances took on a new vigor, and the appearance of the orchard at the close of the summer of 1902 was far better than at the close of 1901. In fact, the disease was so decidedly checked that one could not help being greatly encouraged with the result.

Fig. 19—Souvenir, with top partially cut away.

It should further be stated that, with the checking of the blight in the pear orchard, scarcely a twig blighted in the large variety apple orchard standing adjacent, whereas the previous year twig blight occurred very generally throughout the apple orchard.

The treatment with fertilizers mentioned as being given the private orchards of the writer was repeated in 1902 with apparently almost as good results as at the Station orchard. Duchess and Bartlett showed some blight when the orchard was examined on October 27, 1902. Twenty-one trees in all were affected and two were dead. There was scarcely a blighted twig on other varieties, such as Beurre Brignais, Seckel, Kieffer, etc. While I am not so situated as to give good care to this private orchard, the result of the two years' work was very gratifying.

Spring of 1903.

This season the station orchard has been treated as follows: The few dead limbs and branches resulting from last season's development of blight were cut out when still dormant. No winter wash was used. Though the orchard has a dilapidated appearance from severe cutting, it shows no particular extension of blighted areas on trunks and limbs. Unfortunately the impassable condition of our road to the depot rendered it impossible to secure the material for making the tonic treatment with fertilizer as early as we had wished. The application was prepared, however, as specified under a previous section of this report, and *ten pounds* used broadcast around each tree, on April 22, 1903, spreading the same for a radius of six to eight feet about the trees.

The first Bordeaux treatment was given April 20th, just as buds were opening, and the second May 18th, after bloom had fallen.

The orchard was cultivated three times with a disk harrow, and will be given no further culture or treatment of any sort. The coming fall we ought to be able to make pretty positive statements as to the results of this tonic treatment for pear blight.

At this writing (June 1, 1903) the trees are, with few exceptions, making a vigorous growth, and in some cases forming new heads from bare trunks where the tops were cut away when the trees were twelve and thirteen years old.

Notes on Varieties with Relation to Their Resistance of the Fire Blight.

The undated note was made when the trees were dormant; the dated note, just as this bulletin is sent to press. There is not a fresh case of blight to be found in the orchard at this time (June 1, 1903).

Fig. 20—Souvenir, cut to stump, sprouts after two years growth.

ANJOU. Of this variety there are four standard trees in the test orchard. All of them have shown blight to some extent, two seriously, and were heavily cut back; promise to live. June 1, 1903, two trees

show good vigor; two very weak; foliage shows bad color; trunks almost encompassed by blight; think these two will die this season.

BARTLETT. Four standard trees; of these two have been cut down to stumps. One of these stumps is now sprouting out and appears strong enough to form a new head. The other two trees are almost intact, never having been cut back seriously from the blight; attacks have occurred on fruiting spurs, twigs and trunk; are weak trees. June 1st, one stump is sending up strong shoots; two trees show fair vigor.

BOSC. Four standard trees; one entirely dead from blight and one cut to stump three feet high. The other two have been cut down to short stubs about the head of the trunk, and have made a vigorous growth; perfectly healthy. June 1st, the stump is throwing out sprouts; other two growing vigorously.

BOUSSOCK. Four standard trees. All of these have blighted badly, and have been cut back severely, but at this time are much improved and apparently will recover from the trouble; were large trees. June 1st, are growing and look well.

BUFFUM. Two dwarf trees. These blighted but slightly, yet the trees have at this time been cut out for other reasons than blight.

CLAIRGEAU. Four standard trees. Two are entirely dead from blight; one of the others has been seriously cut back, but has thrown out new growth and is promising. One tree has almost entirely resisted the disease and is in good condition. June 1st, both doing well.

CLAPP. Two dwarf trees and four standard trees; all dead from blight and removed.

DUCHESS. Two dwarf trees. These are both standing, in very fair health; have been but slightly attacked by the blight. June 1st, making good growth.

EASTER BEURRE. Two dwarf and four standards; all dead from blight and cut out.

ELIZABETH. Two dwarf trees. Both are alive, though much injured by the blight. They have recovered and show fair vigor. June 1st, making good growth.

FLEMISH BEAUTY. Four standard trees; all dead from blight. These trees stood in a rather moist, rich soil, which may have caused the blight to attack them more severely than would otherwise have been the case.

HOWELL. Two dwarf trees. One is strong and shows decided tendency to become a standard. The other is weak, not badly attacked by blight. This variety is not at all desirable as a dwarf. June 1st, trees doing well.

IDAHO. Two standard trees; both dead from blight.

KIEFFER. Eight standard trees. These are all alive and in fair vigor. They showed some blight before tonic treatment was applied; none since. This variety resists blight very well, but it is not at all proof against it. June 1st, all in good condition.

LAWRENCE. Two dwarf and four standard trees. The dwarf trees are dead; one of the standards is dead; the three others were severely cut back, but have recovered somewhat and formed new tops. June 1st, growing vigorously.

LAWSON. Two dwarf trees; very strong growers, tending to become standard. This variety is no good. Scarcely attacked by blight. June 1st, in good condition.

LE CONTE. Six standard trees; all dead from blight.

LOUISE. Two dwarf trees. One of these is dead from blight; the other is still alive, but weak; promises to recover. June 1st, tree is now showing fair vigor.

LUCRATIVE. Two dwarf trees. One is dead and the other is weak from the effects of blight and cutting back, but promises to recover. June 1st, making fair growth.

MALINES. Four standard trees; three dead from blight; one cut back heavily, but is now in fair condition, and apparently will recover. June 1st, making good growth.

MARGUERITE. Two dwarf trees; one dead from blight; the other is still alive, but weak; it now, however, promises to recover. June 1st, making good growth.

OSBAND. Three dwarf trees. Two are dead; one still alive, but very much injured. June 1st, making good growth.

POUND. Four standard trees. All have blighted badly and have been cut back severely. They are now much improved and apparently will recover. These were very large trees. June 1st, all growing vigorously.

RUTTER. Two dwarf trees. They have been somewhat injured by the blight, but are in fair condition and much improved since the tonic treatment. June 1st, only slight growth, but promising.

SECKEL. Two dwarf trees. These have never grown well and are very small; have shown almost no blight. June 1st, in fair condition.

SHELDON. Four standard trees. These have all blighted very badly and have been cut down to stumps or short stubs at the head of the trunk. They have grown sprouts, and three promise to recover; other, a stump one foot high, shows some sprouts. June 1st, three trees cut to stubs about head of trunk are growing new tops vigorously; stump is not promising.

SOUVENIR. Four standard trees. Two are entirely dead from blight; one cut back to a stump, from which sprouts have grown, and promises to recover and form a new top; other a weak tree, but not cut so seriously, now promises to live. June 1st, stump growing new top vigorously; other tree only fair vigor.

SUMMER DOYENNE. Four standard trees; all dead from blight. These were among the strongest growing trees in the orchard and stood in good position. Two dwarf trees—one has been almost entirely cut

away; the other has not been affected; stands near small building. June 1st, the weak tree growing very well; the other is vigorous.

SUPERFIN. Two dwarf trees. Both are alive, apparently healthy, though they were attacked especially in spots on the trunk. June 1st, are doing well.

TYSON. Two dwarf and four standard trees. The dwarfs are in fairly good condition and have not blighted severely; the standards all blighted and have been cut back heavily, but they now promise to recover. June 1st, two dwarfs growing well; standards are vigorous and forming new tops.

VICAR. Two dwarf trees. One is dead; the other is much injured by blight, but promises to recover. June 1st, is making vigorous growth.

WHITE DOYENNE. Two dwarf trees; have been injured considerably by the blight, but are now much recovered. June 1st, making good growth.

WILDER EARLY. Four standard trees. Three are dead from blight. One is alive, but rather weak; it promises to recover. June 1st, the one tree is growing finely.

Conclusions.

1. Our efforts to stay the fire blight by cutting out diseased tissues and by the use of Bordeaux sprays over the entire trees, and washes on the trunk, have failed to hold the disease in check, but we think this preliminary effort to control the disease should not be neglected.

2. It appears that we are warranted in saying that the fertilizer used on pear trees suffering from fire blight has enabled them to resist the disease to a very marked degree. These tests must be repeated for a series of years, and under varying conditions, before a final pronouncement can be made.

3. It is, in our opinion, bad policy to cultivate pear orchards in summer, or, in fact, after the bloom falls, and such orchards are apparently more healthy if planted on rather dry, stiff soil.

4. After our experience with the blight, we suggest the following list of varieties for home use and commercial planting. Well treated, these would appear to promise the best results:

For summer: Bartlett and Tyson.

For autumn and late fruit: Seckel, Bosc (finest quality, amateur only), Louise, Rutter, Kieffer (especially for commercial purposes), and Lawrence. This latter, if well handled, can be held until late; quality is fine.

5. Our work is conducted for the purposes of experimental study. We do not think it would be profitable for orchardists to try to save such badly diseasesd trees as some shown in the illustrations.

WILLIAM B. ALWOOD,
Mycologist, etc.

Issued June 30, 1903.